Cold Test Support for the Gunite Tanks Remediation Project at Oak Ridge National Laboratory

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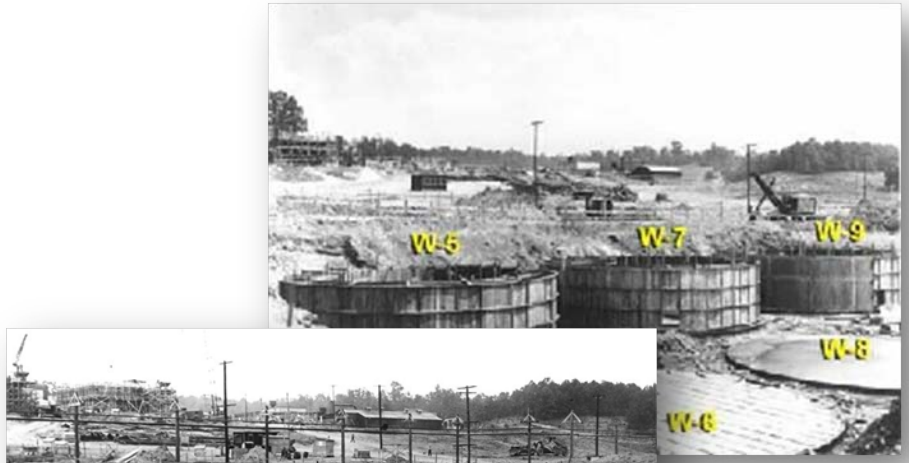
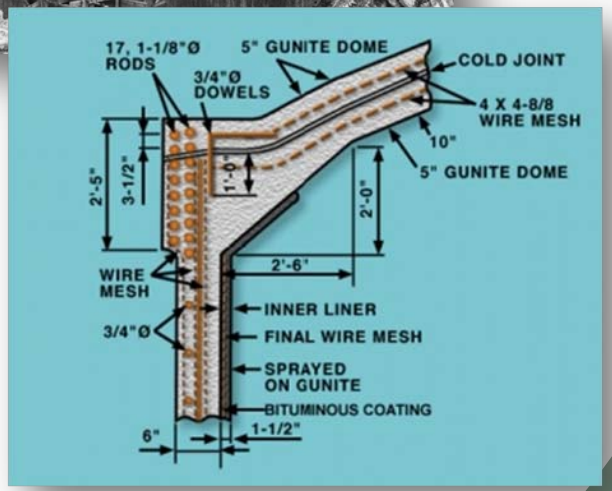
History

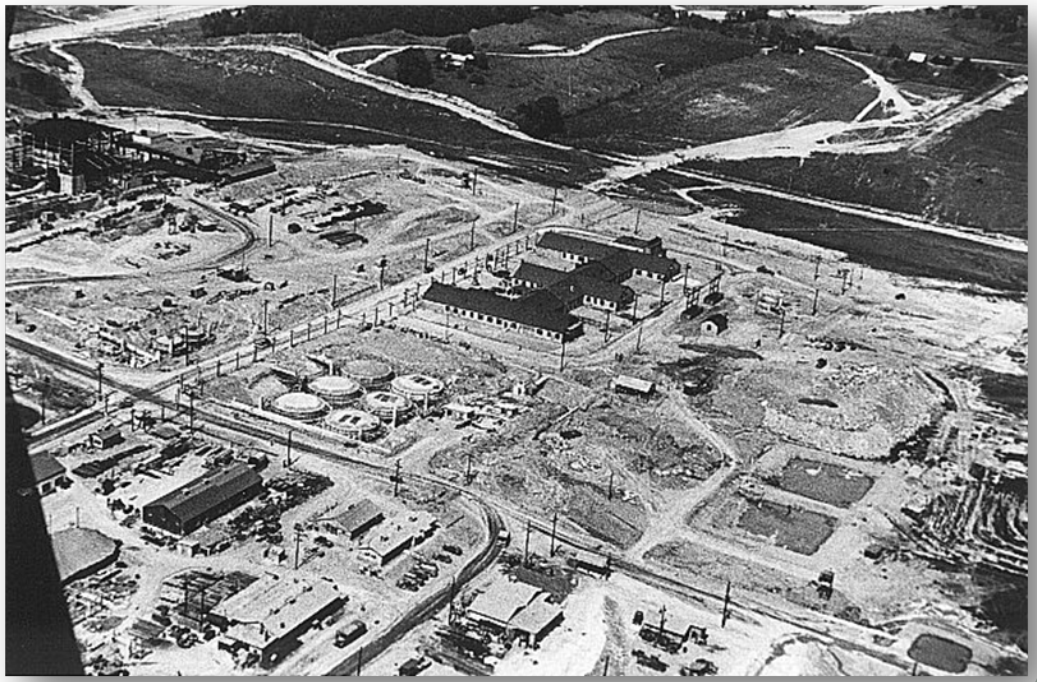
- In 1943 twelve underground storage tanks were constructed of ”gunite" - a sand and Portland cement mixture sprayed over a wire mesh and reinforcing rod frame.
- The tanks were used to store wastes from “pilot scale” separation operations and research missions.
- The tanks were removed from service in the early 1970’s.
- Most (~90%) of the accumulated sludge and liquid waste was removed during an 18 month campaign from 1982 through 1984.





Gunite Tanks Project Goal

- Remove the remaining transuranic sludge (~94,000 gal) and supernatant waste from nine of the 55-year old gunite tanks located in the main plant area of Oak Ridge National Laboratory
- Consolidate the waste in the permitted Melton Valley Storage Tanks
- Address final closure



ORNL during construction - 1943

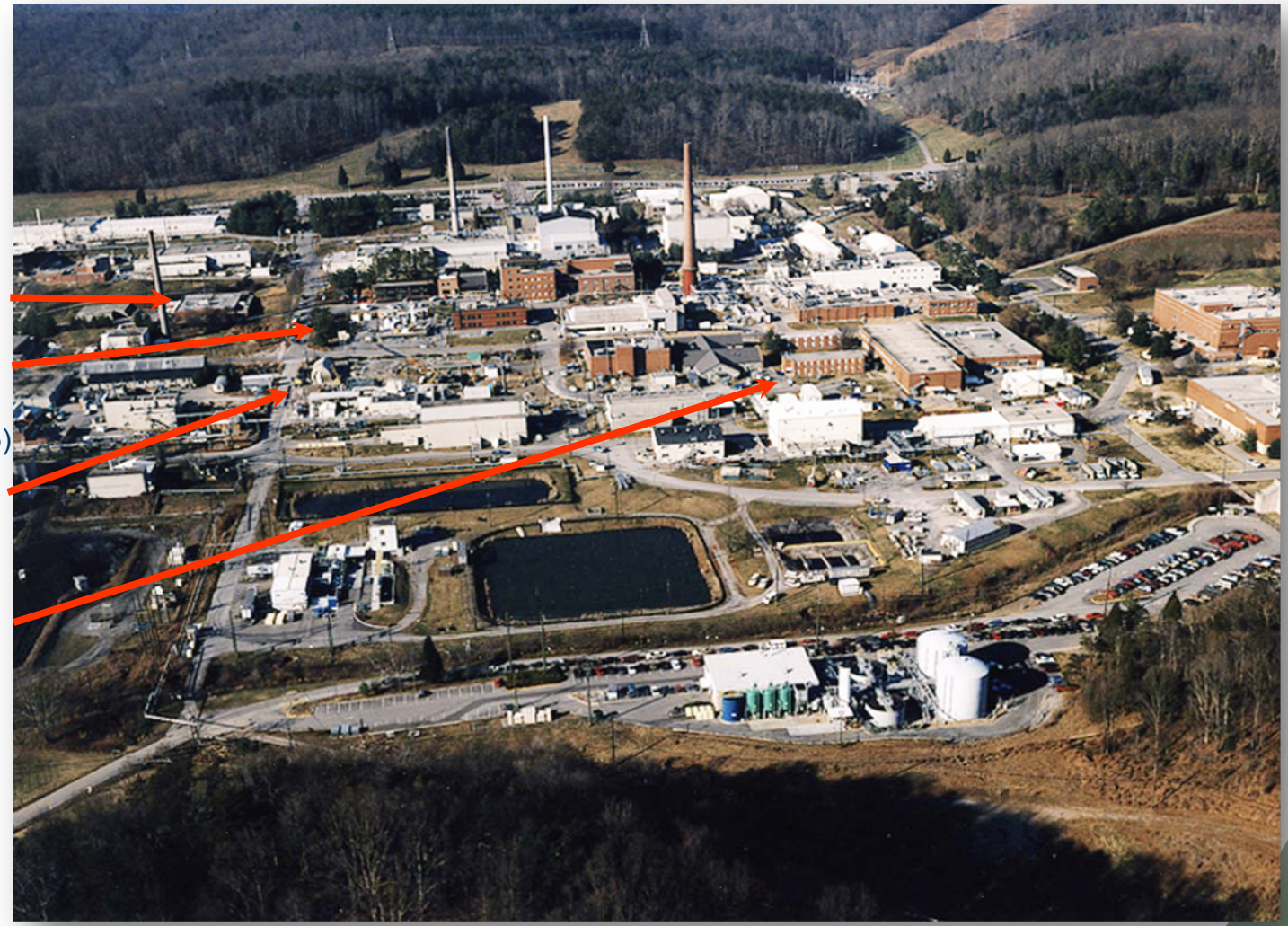
The Gunite Tanks are Located in Central ORNL

Old Cafeteria

North Tank Farm
(W-1, W-1A, W-2, W-3, W-4, W-13, W-14 & W-15)

South Tank Farm
(W-5, W-6, W-7, W-8, W-9 & W-10)

TH-4



Status

- January 2001 – Completed waste removal operations in the nine largest gunite tanks
  - Removed 439,000 gallons of waste (sludge and supernate) containing 82,000 curies
  - Sludge successfully transferred to the Melton Valley Storage Tanks
  - Completed waste retrieval operations ~5.5 years ahead of the original baseline schedule
    - Savings of over $120 Million
- Site demobilization completed
  - Waste has been containerized for disposal and equipment either reused or disposed
  - Site is now a parking lot

Approximately 40 Technologies were Tested and Deployed*

Tank Sampling, Characterization, and Modification

- Floating boom In tank Camera & Sampling Device
- Ponar Sampling Tool
- Sludge Mapping Tool
- Topographical Mapping System
- Large Diameter Coring Saw for Tank
  - Riser Installation
- Remote Video Cameras & Lighting
  - Multiplexed Pan & Tilt Controller for multiple Cameras
- Gunite Isotope Mapping Tool
- Characterization End-Effector
- Feeler Gauge
- Hydraulic Shears
- Pipe Cutting Saw
- Pipe Plugging Tool
- Wall Coring Tool
- Wall Scraping Tool

Waste Mixing

- Flygt Mixers
- PulsAir Mixers
- Russian Pulsating Mixer Pump

Sludge Heel Retrieval and Wall Cleaning

- Modified Light Duty Utility Arm
- Houdini I Remotely Operated Vehicle Houdini II Remotely Operated Vehicle
- Decontamination Spray Ring
- Waste Dislodging & Conveyance System
  - Confined Sluicing End-Effector
  - Hose Management Arm
  - Axial Flow Jet Pump
  - Flow Monitor & Sampling Device
- Gunite Scarifying End-Effector
- High Pressure Pump for Wall Scarifying
- Gripper End-Effector Hydraulic Pump
- Linear Scarifying End-Effector

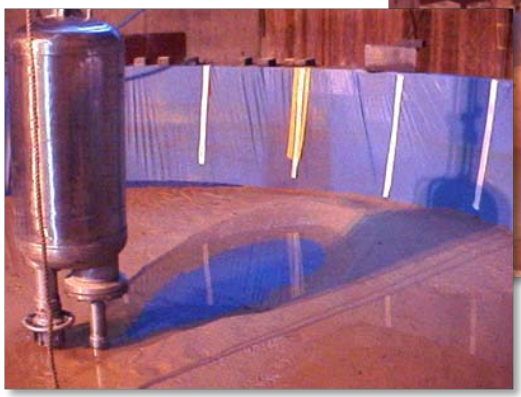
Waste Conditioning and Transfer

- In-line Sampler
- Waste Removal & Transfer System
- Sludge Conditioning System
  - Primary Conditioning System Module
    - In-Line Sampler
    - Size Classifier
  - Disc Flow Pump
  - Solids Monitoring Test Loop
    - Particle Size Analyzer
    - Ultrasonic Suspended Solids Monitor
    - Coriolis Density Meter

* Refer to Lewis, B.E, et al., *The Gunite and Associated Tanks Remediation Project Tank Waste Retrieval Performance and Lessons Learned*, ORNL/TM-2001/142/V1, Sept. 2003, for additional information.

The Gunite Tanks Remediation Project
South Tank Farm Operations

Tanks Technology Cold Test Facility (TTCTF)



Tanks Technology Cold Test Facility (TTCTF)

TTCTF, Gunite Tanks, and Other Cold Test Sites









Simulants

- **Physical Simulants for Tank Sludge**
  - **Sand (medium grain)**
  - **Sand/Kaolin clay mixture**
  - **Soil and gravel**
  - **Obstructions (piping, cables, debris)**
- **Issues**
  - **Actual tank sludge and solids varied significantly**

What went well

- **Frequent communication with staff, management, and stake holders ensured continuing support and ownership**
- **Control and archival of key documentation to support readiness reviews and inquiries**
- **Acceptance testing at vendor facilities to minimize cost and increase efficiency**
- **Cold testing was conducted at various locations to meet testing requirements and schedule demands (TTCTF, vendor facilities, GAAT site, other sites)**
- **Independent sub-systems testing prior to integrated systems testing to solve potential problems at the lowest level of complexity**

What went well (cont.)

- **Cold tests used to develop operating procedures and provide operator training**
- **Modifications and repairs to equipment and systems performed during cold testing resulted in lower employee exposure and project cost during hot deployment**
- **Developed systems/tools with complementary and/or redundant capabilities**
- **Use of full PPE during portions of the cold testing ensured that activities could be performed within the confines of the PPE**
  - Allowed personnel a chance to develop specialized tools and techniques that can decrease exposure during field operations
  - Much easier to develop a solution to an equipment or process problem during cold testing than during field deployment where access is significantly limited

What went well (cont.)

- **A phased and integrated approach to waste retrieval operations was used for the GAAT Remediation Project. The project promoted safety by obtaining experience from lower-risk operations before moving to higher-risk operations.**
  - Acceptance testing => Cold testing of sub-systems => Cold testing of integrated systems => Low activity hot testing => High activity remediation
  - Allowed project personnel to become familiar with the tanks and waste, as well as the equipment, processes, procedures, and operations required to perform successful waste retrieval

- **Almost 94,000 gal of remote-handled transuranic sludge and over 81,000 Ci of radioactive contamination were safely removed from the tanks**

Advice

- **Equipment**
  - Consider ergonomics for repetitive manual operations
  - Use high quality components and parts
  - Understand the nature of prototypic systems
  - Plan for valve and line failures in initial prototypes
  - Ensure fastener integrity and robustness
  - Maintenance issues are key to success. Design for:
    - High reliability
    - Ease of maintenance
    - Replacement vs. repair
    - Maintenance friendly containment
  - Practice preventative maintenance and inspections to identify problems and extend operating life
- **Chemical hazards**
  - Hydraulic fluid compatibility with valves and electrical system components
  - Know the environment but expect something worse – Waste material variability will likely be greater than initially expected

Advice (cont.)

- **Incidents and occurrences**
  - Electrical power must be conditioned to accommodate drive system requirements
  - Condensation in HEPA filters systems must be contained and properly handled
- **Operator training**
  - Cross training on various systems may be required to optimize staff utilization
- **Laboratory analysis issues**
  - Instrumentation does not always agree with analytical results
- **Shift turnovers and communications**
  - Cold testing did not require shift work
  - Work schedules during hot operations were structured around weather considerations
- **Test change control**
  - Ensure that test changes are adequately documented
- **Ensure that system components are thoroughly tested under a broad range of conditions**

Advice (cont.)

- **Understand the limitations of mixing systems**
  - Flygt mixers – positioning and blade construction
  - Pulse air mixers – air pressure and plugging
  - Pulsating mixer pump – environmental effects
- **Control system**
  - Control system interfaces should be designed with consideration for the talents, abilities, and background of the personnel who will be operating the equipment
  - User-friendly straightforward equipment interfaces should be used
  - Operator input should be used during the design to ensure ownership and acceptance of the equipment in the field